Alkynes

Introduction

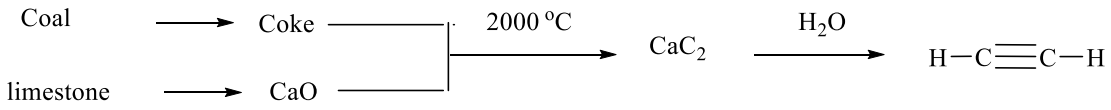
alkanes have the general formula CnH_2n+2 alkenes have the general formula CnH_2n we shall take up alkyne, alkynes have the general formula CnH_2n-2 . The formula indicates ,they contain an even smaller proportion of hydrogen than the alkenes ,and display an even higher degree of unsaturation .

Physical properties of alkynes

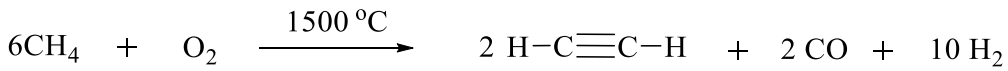
Being compounds of low polarity, the alkynes have Physical properties that are essentially the same as those of the alkanes and alkenes, they are insoluble in water but quite soluble in the usual organic solvents of low polarity, solvents such as benzene ,ether ,chloroform they are less dense than water. As we can see the boiling points and melting points, rise the number of carbons increases .the process of boiling and melting point require overcoming the intermolecular forces of a liquid and a solid ; the boiling points and melting points, rise because these intermolecular forces increases as increases molecules get larger they are very nearly the same as the boiling point of alkanes or alkenes , with same carbon skeletons .

Industrial Source of acetylene

The alkyne of chief industrial important is the simplest member of the family acetylene it can be prepared by the reaction of water on carbide calcium CaC_2 , which itself is prepared by the reaction between calcium oxide and coke at the very high temperatures of the electric furnace .

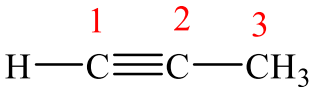


Also acetylene preparation from oxidation methane by high temperatures

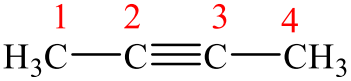


Nomenclature of alkyne

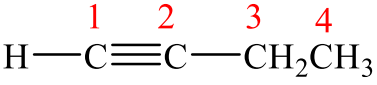
Like the alkanes and alkenes, the alkynes from a homologous series, the again being -CH_2 - .The alkynes are named according to two systems In one, they are considered to be derived from acetylene by replacement of one hydrogen atoms by alkyl groups as like examples.



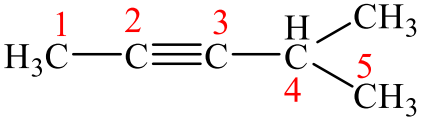
1-propyne
methylacetylene



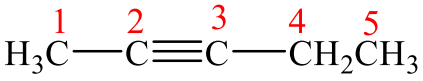
2-butyne
di methyl acetylene



1-butyne
Ethyl acetylene



4-methyl-2-pentyne
Methyl isopropyle acetylene



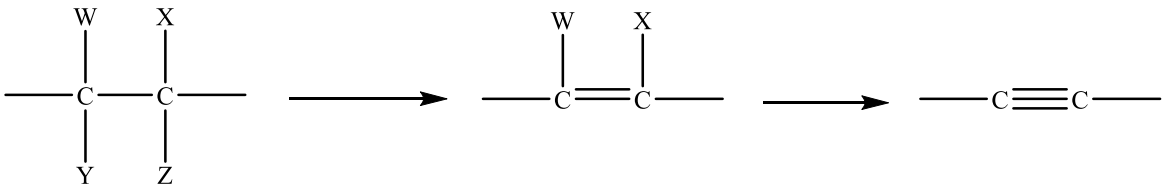
2-pentyne
Methyl ethyl acetylene

***** In two For more complicated alkyne the IUPAC names are used. The rules are exactly the same as for the naming of alkenes , except that the ending **–yne** replaces **–ene**.

Preparation of alkynes

A carbon –carbon triple bond is formed in the same a double bond elimination of atoms or groups from adjacent carbons .the group elimination and the reagents used are essentially the same as the preparation of alkenes .

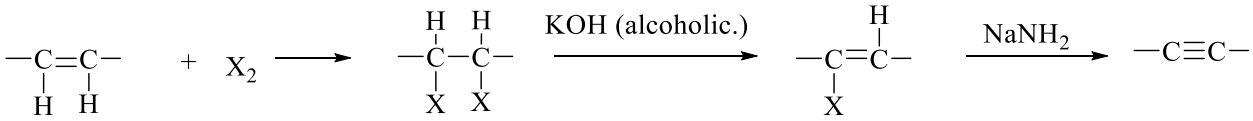
General equation



1- **Dehydrohalogenation of alkyl di halide**

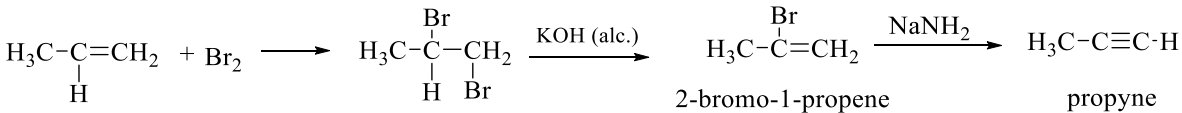
Dehydrohalogenation of alkyl di halides is particularly useful since the dihalides themselves are readily obtained from the corresponding alkenes by addition of halogen .this amounts to conversion –by several steps-of a double bond into a triple bond .

Dehydrohalogenation can generally be carried out in two stages as shown.



vinyl halide
very unreactive

For Example:-



propene

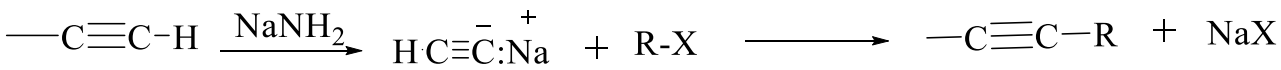
1,2-di bromo propane
or propylene di bromide

2-bromo-1-propene

propyne

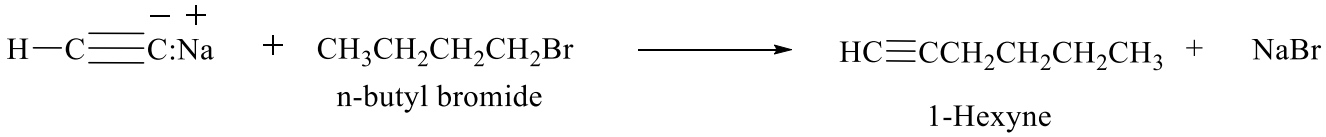
2- **reaction of sodium acetyl ides with primary alkyl halides**

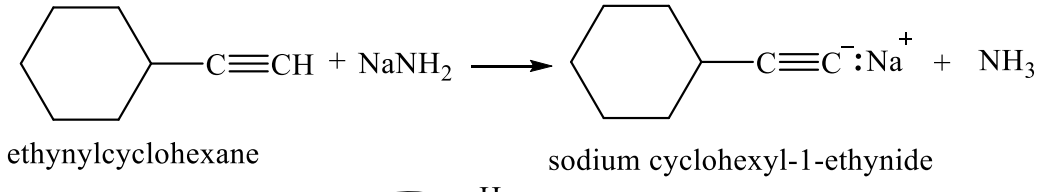
the reaction of sodium acetyl ides with alkyl halides allows the conversion of small alkynes to larger ones. This reaction is limited by the use of primary alkyl halides due to the high tendency of secondary and tertiary alkyl halides to elimination reaction.



R must be $^{o}1$

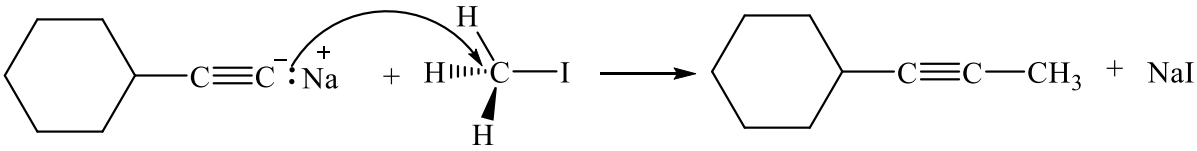
For Example:-





ethynylcyclohexane

sodium cyclohexyl-1-ethynide

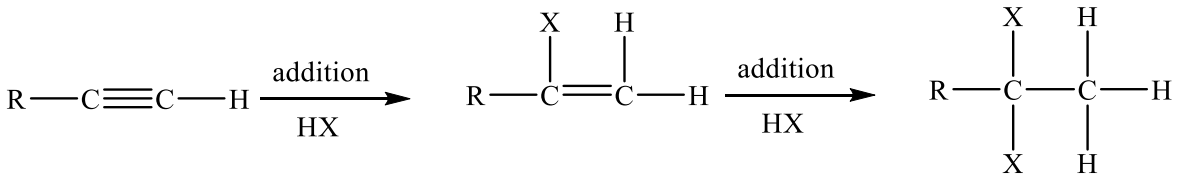


1-propynylcyclohexane
1-cyclohexylpropyne

Reaction of alkynes

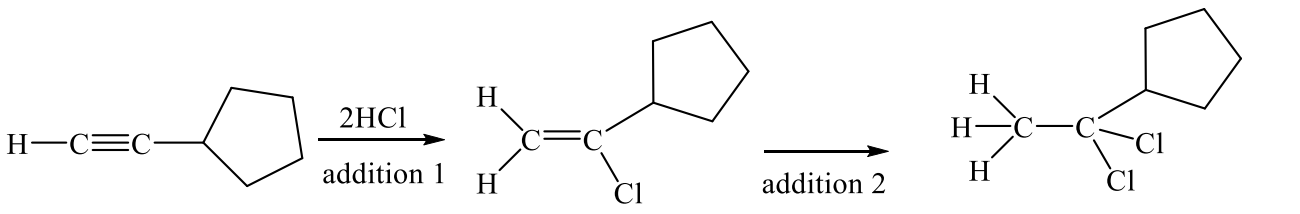
The triple bond of alkyne under goes most of electrophilic addition reaction (HX , H_2O , H_2 , X_2).

General equation :-



1. Addition of hydrogen halide an Alkyne

Stepwise addition of two moles of HX Markovnikove region chemistry

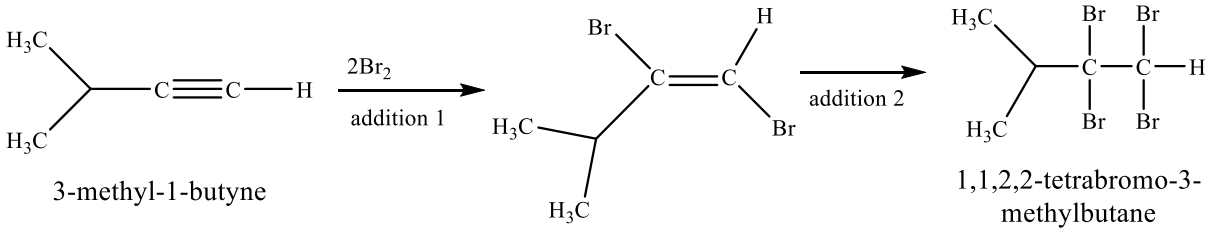


ethynylcyclopentane

(1-chlorovinyl)cyclopentane
1-chloro-1-cyclopentylethene

(1,1-dichloroethyl)cyclopentane

2. Addition of halogen to an Alkyne



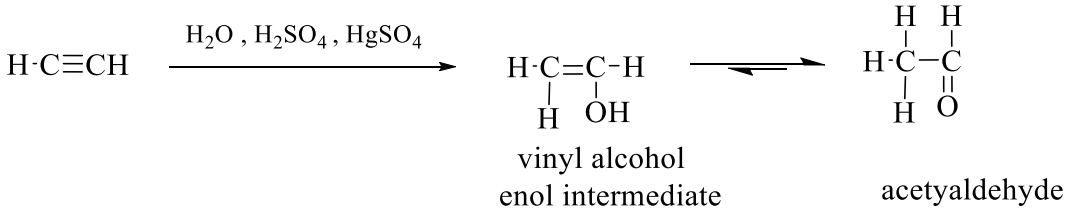
(*E*)-1,2-dibromo-3-methyl-1-butene

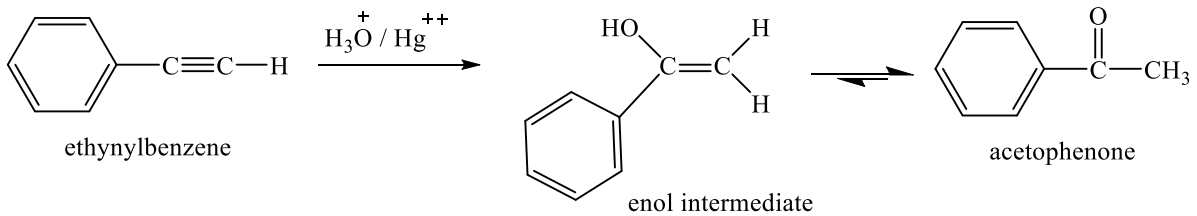
Stepwise addition of two moles of X_2

3. Addition of H_2O to an Alkyne

Addition of water to acetylene to form acetaldehyde ,which can then be oxidized to acetic acid , is an extremely important industrial process.

From the structure of acetaldehyde ,it at first appears that this reaction follows a different pattern from the others , in which two groups attach themselves to the two triply –bonded carbons .actually ,however ,the product can be accounted for in a rather simple way .

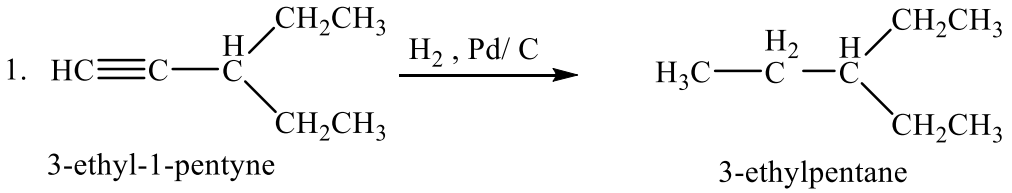




4. Reduction of an Alkynes

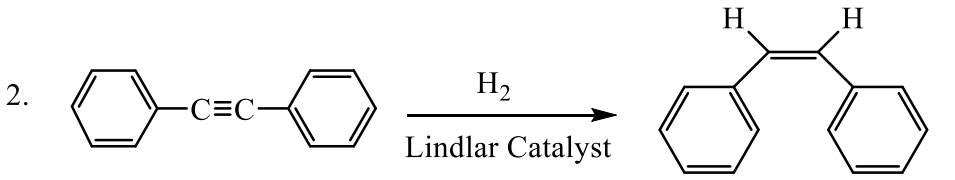
Reduction of an Alkynes with hydrogen in presence of ordinary nickel , platinum or palladium gives **alkanes**

Hydrogenation of alkynes with Lindlar's Catalyst gives a **Cis alkene.** Hydrogenation of alkynes in presence lithium and liquid ammonia gives a **Trans alkene**.



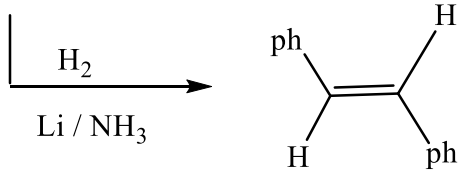
3-ethyl-1-pentyne

3-ethylpentane



1,2-diphenylethyne

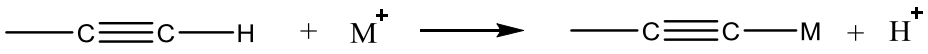
Cis-1,2-diphenylethene

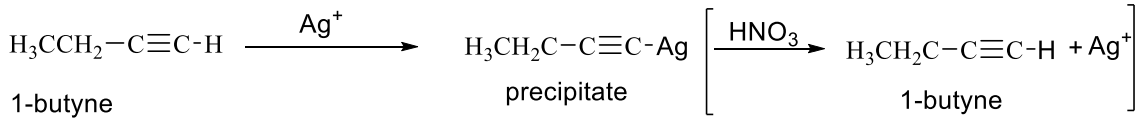


Transe-1,2-diphenylethene

5. Formation of heavy metal acetyl ides

The acidic acetylenes react with certain heavy metal ions chiefly Ag^+ and Cu^+ , to form insoluble acetyl ides formation of a precipitate upon addition of an alkyne to a solution of $AgNO_3$ in alcohol ,for example is an indication of hydrogen attached to triply-bonded carbon .this reaction can be used to differentiate terminal alkynes (those with the triple bond at the end of the chain) from nonterminal alkynes



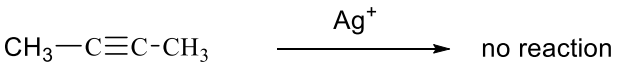


1-butyne

precipitate

1-butyne

A terminal alkyne



non -terminal

2-butyne